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*WHAT TRAINING IN PHYSIOLOGY AND HYGIENE MAY WE REASONABLY EXPECT OF THE PUBLIC SCHOOLS.**

IN the public schools of to-day various subjects are taught, and for various reasons. Some, like arithmetic or the reading and writing of English, are indispensable tools of modern civilized life; others, like geography and history, impart necessary information or promote general intelligence; still others, like algebra, geometry and Latin, are agents of mental discipline or else afford necessary preparation for subsequent work. Physiology and hygiene, the studies with which we are concerned in the present paper, were introduced into the public schools for the express purpose of affording information concerning the structure and functions of the human body, being expected thereby to contribute to the preservation and promotion of health; and they have kept their place, in spite of serious shortcomings, as a concession to the practical importance of sound ideas concerning health and disease.

The training which may reasonably be expected in the reading and writing of English, in arithmetic, in geography or in Latin, is the subject of frequent discussion in educational gatherings and is doubtless influenced by such discussions; but it is determined chiefly by the exami-

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nation requirements of the upper grades and by the entrance requirements of higher educational institutions. With physiology and hygiene the case is different. Proficiency in these is rarely made a condition of promotion. They are seldom included in the list of requirements for admission to colleges or technical schools, and never in those for medical schools. They are not often much considered in educational congresses. And yet it is doubtful whether any subject in the whole curriculum of the public schools is of greater intrinsic importance as a preparation for life, or is capable of affecting more profoundly the whole mental attitude of men and women toward an enduring and well-organized civilization.

The real importance of physiology and hygiene is unquestionably far greater to-day than it was twenty-five years ago. At that time physiology was a new science. It was still commonly taught in medical schools as an adjunct to anatomy, and the double-headed professorship of anatomy and physiology had not then become extinct. As for hygiene, this was largely a body of precepts based upon *a priori* reasoning, or else of deductions derived jointly from anatomical knowledge, common experience and common sense. Disease was only a little more baffling that health, and the promotion of one poorly understood condition by the prevention of one still less comprehended was not only a most unsatisfactory, but a most unscientific undertaking. Nevertheless, in spite of this difficulty and uncertainty, physiology and hygiene, such as they were, have steadfastly held their place in the curriculum of the public schools, no doubt because of an unconquerable belief that they should somehow furnish to the developing mind and the forming character some real and lasting help in the preparation for life.

And at last this belief seems likely to bear fruit and to justify its long and patient expectation. For to-day physiology has won an established and recognized position as an independent science. It has become entirely separated from anatomy. It has its own professors in our medical schools and universities. We have a strong and active American Physiological Society, composed of expert investigators and teachers, and a flourishing *American Journal of Physiology*, which publishes regularly budgets of important discoveries.

In hygiene the progress has been even more remarkable. Twenty years ago the infectious diseases were as mysterious as ever, but to-day we understand the essentials of their operation and also to a great extent the mechanism of their dissemination and, therefore, in many cases the ways of their prevention. The clouds of mystery which until lately hung about them have been largely cleared away, and a new hygiene, based partly upon experimental physiology and partly upon experimental medicine, has come into being. Meantime an enlightened sanitary engineering is building improved sewers and water-works and dealing with the purification of sewage and water, with the construction of sanitary pavements, with the dust nuisance and with efficient scavenging and garbage destruction. Boards of health are equipped with laboratories for sanitary testing and research. They are supervising the medical inspection of schools. They are isolating cases of infectious disease and securing the disinfection of clothing and of houses. They are enforcing vaccination. They are vacating unwholesome dwellings.

Educators themselves are engaged in hygienic endeavors. They are providing for playgrounds. They are beginning to attend as never before to the ventilation of school buildings. They are interested in the lighting of school-rooms, in the seat-

ing of the pupils, and in their sight and hearing. The home also is receiving the attention of hygienists. Its site, its drainage, its wall papers, its ventilation, its cookery, are undergoing careful investigation.

And, finally, personal hygiene—the care of the individual body, its exercise, its fatigue, its work, its rest, its play, its clothing, its bathing, its hunger and thirst and sleep, its growth and its old age—is being dealt with to-day, not superficially and by tradition or experience alone, as formerly, but also by experiment. Physiology and hygiene have become experimental sciences, and have thus taken on a new and higher value. In view of all these marvelous changes, we may properly ask and undertake to answer the question which forms the subject of this paper.

But first and always we must keep steadfastly in mind the end and object sought for in the training under consideration. This has always been and still is primarily practical and technical, namely, a sound preparation for the right conduct of physical life. For although it is one argument for increasing the efficiency of instruction in these subjects that they give information on matters of great human interest, and that, when rightly taught, they are of high educational value, still the primary purpose of teaching them is not to give information nor mental discipline, but because their subject matter is of immediate and enduring importance in determining and promoting the right conduct of the physical life, and especially the preservation and promotion of health. Their value is special rather than general, practical rather than cultural, technical rather than disciplinary.

We may confess frankly that physiology and hygiene have not always hitherto justified their place in the curriculum by their results. It would be going too far to deny that they have been without influence, or that in exceptional cases they have not been valuable; but they certainly have not, on the whole, accomplished what was originally expected of them. Their results have been disappointing, and it is by no means unusual to hear competent educators express the opinion that it would be better to drop them altogether. Physiology and hygiene are too frequently looked upon by school authorities as an unavoidable necessity, and by teachers and pupils as a bore. And yet we doubt whether any of these superintendents or teachers would care to take the responsibility of banishing them altogether from the curriculum. They may not be a success; but the conviction remains that they ought to be a success, and doubtless the hope, however faint, that some day they will be.

The present unfortunate condition of affairs is due, in our opinion, largely to the fact that the primary purpose of these subjects in the curriculum has been neglected or forgotten. They were perhaps introduced prematurely, as has been suggested above. Fifty years ago anatomy was the one branch of medical science about which definite statements could be made, but little was known about physiology, and the great field of hygiene was largely a matter of either popular tradition or impressions derived from personal or racial experience, often, indeed, surprisingly accurate, but nevertheless lacking in the certainty of experimentally demonstrated fact.

It is only exact knowledge which lends itself to school instruction. We do not teach electricity in our courses in physics by speculating about thunderbolts or the nature of magnetism, but by telling what we know of the production, the conduction or the induction of electrical energy. We leave the region of the indefinite to the investigator. It is easy to see, therefore, how it came

about at the outset that in planning the work in physiology and hygiene in schools the details of gross and minute anatomy should have formed the major part of the whole. Function was treated but sparingly, because very little was known about it; and considerations of health and disease occupied an insignificant place simply because definite statements could not possibly be made about them. The instruction in school physiology and hygiene was chiefly anatomical for the reason that the dissecting room was the sole laboratory of the medical school. It was the one region of real and accurate knowledge of the subject.

We have said above that this condition of hygienic knowledge has been entirely transformed during the last twenty years. The physician is far less mysterious in his manner than formerly, because his fund of knowledge is vastly greater. He often explains his reasons to his patient and discusses the facts of his profession with 'the laity,' where he would not have done so fifty years ago. It was within twenty years that one of our leading pathologists was heard to define malaria by remarking, 'When you don't know what it is, it is malaria.' To-day he would not give that definition, but would delight to describe the wonderful story of those discoveries which within a score of years have led to our present satisfactory understanding of the nature and mode of dissemination of this disease.

The teaching of physiology and hygiene in the public schools has lagged far behind this march of medical and hygienic progress. It is inexcusably behind the times. We now have facts which any one can teach and which should be made known as a preparation for the proper conduct of life; and it is these facts which should form the main part of the teaching. The subject matter should be thoroughly revised, and in no more important particular than in the restriction of anatomy to the minimum amount needed to give a clear conception to the general structure of the body as a mechanism and of the normal working of that mechanism. In a rural school-house on the Maine coast we once saw upon the blackboard, painfully written down by a fisherman's child, a long and learned list of the bones found in the human body. Even for a medical student the list, as such, apart from the physiology and surgery of the bones, would have been of small value; for the children of fishermen, the bones of the cod or haddock or of the domestic animals would probably have been of greater consequence. An arid osteology is a poor introduction to the study of modern hygiene, and one not calculated to arouse a compelling interest in the subject.

Similar considerations hold with regard to the teaching of physiology. The educational value of this science, it is true, is much greater than is that of pure anatomy, for, in the first place, it is more interesting. Not only in childhood, but throughout life, we do not care greatly about the parts of a machine unless we know or can guess their use. From this point of view physiology is a good teaching subject, and all the more so because it deals with a machine in which most of us are naturally interested. The study of the activities of the human body has also the highest philosophic value. It imparts that first and most important lesson for the conduct of life—a lesson which every person leaving the upper grades of the public schools should carry away with him—that the human body has a material basis and is a *mechanism*, a *machine*. We must constantly recall, in order to emphasize, Huxley's saying that 'the distinctive feature of modern as contrasted with ancient physiology' is 'the fundamental conception of the living body as a physical mechan-

ism.' That this fact is not with most people a part of the philosophy of living is shown by the use and abuse of patent medicines and the frequent neglect of the commonest care of the body, such as would be wisely bestowed on a watch or a bicycle.

We have urged that anatomy has no place in the public school curriculum except as it is necessary to the understanding of the problems of physiology and hygiene; and we shall see it cut down to the minimum needed for this purpose without the slightest regret. We should not feel the same if physiology were similarly made strictly subservient to personal hygiene, that is, if, in doing so, its philosophical value were neglected; but, fortunately, this is not necessary. The physiology which is most useful in understanding the problems of personal hygiene is almost exactly the same body of facts which has the greatest philosophic value; and the method of presenting them is the same for the one purpose as for the other. We have not the time to enter into details in this matter, but we are speaking from experience and are sure of our ground. The instruction in physiology should aim at the outlines of the more important functions of muscular contraction, nervous activity, circulation, nutrition, temperature regulation—all of these expressed as far as possible in terms of physics and chemistry. It should endeavor to avoid needless details. For example, the pupil should understand that the heart is a force pump, but it is not necessary that he should understand the exact structure or mechanism of the auriculo-ventricular valves.

Again, physiology should not be made primarily, or even to any large extent, in public schools, a means of laboratory training. Such training can be had more readily and more advantageously in chemistry and physics. To attempt to give the same laboratory training in physiology as in these subjects would inevitably be to consume precious time which is urgently needed for hygiene. The fundamental facts of physiology can be demonstrated and enforced in the laboratory, even in common schools, without much difficulty, and we would not for a moment depreciate the value or the necessity of a certain amount of this kind of instruction; but the use of the laboratory (always time-consuming) must not be allowed to distract attention from the true function of physiology and hygiene or to interfere with its fruitful realization.

A course of moderate length in physiology should suffice to impart enough facts of structure and function to furnish a solid basis for sound training in hygiene, and to give meanwhile an abiding sense of the material composition and mechanical character of the human body and some knowledge of its environment and operation. With so much of preparation it is easy to pass on to a practical consideration of health and disease, the means of promoting the former and of avoiding the latter. Health becomes simply normal, disease abnormal, living. Such terms as 'constitution,' 'strength,' 'weakness,' 'feebleness,' 'robustness,' are easily understood by constant reference to mechanisms, well or poorly made, or to structures, strong or weak. Wounds become interference caused by invasions or damage by extraneous matters—bullets, knives, parasites, clubs, dogs, slivers—which are as obviously out of place in living mechanisms as dirt in the works of watches. Germs are microscopic invaders, microscopic parasites. They enter and wound and kill, not mysteriously, but by damaging or interfering with the human mechanism. Best of all, they can often be kept out by the avoidance of exposure, as truly as bullets can.

Passing on to the strictly hygienic part of the subject, first in logical sequence comes personal hygiene, the proper regulation of the activities of individual life—

muscular work, mental activity, feeding, the protection against colds and other inflammations, the care of the body by bathing and clothing and the like. These should not be touched upon in short paragraphs which, like after-thoughts, conclude the chapters on anatomy or physiology, but should be separately and fully treated for their own sake, and from the standpoint of the organism as a whole rather than from that of special organs. These are subjects about which every one needs real and true information, and sooner or later seeks it. Shall such knowledge be obtained from the public schools, or sought unwisely and in vain in the brazen advertisements of magazine originators of new systems of physical training, or in the rash and not often disinterested advice of advocates of new breakfast foods?

Modern hygiene begins with the individual, but deals also with the hygiene of the family, of the community, of states and of nations. In a rapid review of the place which these branches of the subject should occupy in our preparation for sound private and public life, it must not be forgotten that the great majority of the pupils in our public schools have no opportunity or intention to enter colleges or higher schools, and yet are likely to become householders, housekeepers, heads of families or citizens. The principles underlying household or domestic hygiene and sanitation therefore claim some consideration at their hands. These should include such questions as the proper site of the house, the value of fireplaces as ventilators, the importance of wall papers free from arsenic, the advantages of bare floors, and of simple rugs as compared with carpets difficult to clean, the necessity of a pure and abundant water supply, the desirability of prompt removal of wastes by drainage and by such other devices for rural communities as may be made most sanitary under the circumstances, the dangers of damp cellars with the reasons why cellar dwellings are so peculiarly unwholesome, the dangers of illuminating gas (especially the modern so-called 'water gas'), the need of careful consideration and frequent inspection of gas fixtures to avoid small but dangerous leaks, and other similar matters bearing directly or indirectly upon the welfare and sanitary condition of the home. Here might well be told the truth in regard to the advantages and dangers of cesspools and sewers, and of leaky or otherwise defective plumbing.

Place should also be found, and might easily be made by the sacrifice of some osteology and histology, for a brief consideration of the health of communities, such as thickly settled neighborhoods, growing towns or cities; of the dangers attending impure water supplies and defective sewerage systems; and the importance of methods for the sanitary removal and disposal of garbage, rubbish and the other wastes of life. Something might well be said regarding the need of proper municipal supervision of all these matters as the essential of a rational municipal sanitation and of the sanitary value of good public service. Here also might be taken up the advantages and the right use of municipal parks, playgrounds and gymnasia, of public lavatories, water-closets and washhouses; of smoke abatement and noise suppression; and something said regarding clean streets and the thoughtless scattering of papers, banana skins and the like rubbish, which necessitates a costly scavenging; something regarding pure ice and especially pure milk—problems in the solution of which all classes of the community must eventually take an active interest and participation, if reform is to come.

And, finally, room should be found for a brief explanation of quarantine, its advantages and disadvantages; the isolation of cases of infectious disease and the reason why this is so essential to the public,

though so inconvenient to the individual; the necessity for public hospitals for contagious diseases and for municipal or state sanatoria for tuberculosis; the fundamental problems of international hygiene; public food inspection, such as that conducted by the federal government for trichinosis in pork to be exported to foreign countries; and other problems calling for intelligent cooperation of the citizen in national and international hygiene.

Trained along these lines, the youth of America, whether or not afterwards going to college or technical school, would enter upon their maturer life with some realizing sense of the general structure and operation of the body as a physical mechanism, and the necessity of obedience to physical laws. They would become familiar with the sources of diseases and with some of the more obvious ways of avoiding them. They would have some intimation of their duty, not only to themselves and to any families which they might afterwards have, but also concerning wholesome houses, pure supplies, the safe disposal of wastes, and some of the problems of the municipality, and even of the nation, of which they are units.

We have, of course, to meet the important objection which will be urged against our point of view, that, desirable as all these things may be, the time available is too short for proper dealing with them. This, however, we deny. Time enough to do all these things and to do them well, either is now or lately has been found in the public schools in the various courses for instruction in physiology and hygiene. It will be necessary, it is true, to revise and bring up to date our subject matter and our methods of instruction. We must teach less about bone and sinew, and more about muscle and nerve. We must teach less about anatomy and histology, and more about the germ theory of disease, about polluted water and polluted milk. We must simplify every statement and eliminate the unimportant. We must not seek to make of physiology a training in the precision of measurements, or in scientific method, or in anatomy, or in physiological chemistry. Some experiments must be made by the students, and demonstrations by the teacher must abound; but we must keep steadily in view the practical object for which chiefly school time is, and long has been, dedicated to physiology and hygiene, namely, the rational conduct of physical life.

Above all, we must insist upon relief from the incubus of that 'scientific temperance' instruction, so called, which has too long rested upon the teaching of physiology and hygiene, winding its tentacles about it and, octopus-like, sapping its strength and crushing out its usefulness. On this subject let us have no misunderstanding. The evil effects of the use of alcoholic drinks must be fully and clearly inculcated. The youth of America must be thoroughly informed of the insidious dangers which lurk about strong drink. But, on the other hand, we must never forget that the public schools are no place for any propaganda and that the freedom of teaching must not be surrendered even to reformers.

Whether we are pleased with the fact or not, modern life has become more strenuous. In order to achieve success, the individual must do more in a given time; hence the urgent importance of a personal hygiene which shall really guide him in the proper care of the body. Meantime the care of the public health has become one of the most important functions of government, and it will be increasingly important in the future. Its success in America must largely depend upon an enlightened citizenship to which it can look for support. We now teach history and eco-

nomics and civics with some reference to the future life of the public school pupil as a citizen. Our teaching of hygiene should keep in view the same great end, and if this paper draws attention to the lamentable inadequacy of our present instruction in that subject to this purpose, our object will have been accomplished.

But much more is needed. We need a clear conception of the true place of physiology and hygiene, but we need also the proper teachers to realize that conception. If the subject is as important as we have represented, it should be taught by teachers specially trained. In the higher grades of our schools we often have special teachers of languages, of history and civics, of mathematics, of the natural sciences; but it is rare indeed to find physiology and hygiene in the hands of teachers who have had special training in these subjects. Too frequently they are imposed upon the least experienced member of the staff, whose connection with the school is too recent or whose tenure is too precarious to allow refusal. All this must be changed. The exact method of securing the trained instructor may often be left to local conditions. At times, medical examiners, the demands of whose practice are not distracting, and who are at the same time good teachers, may fill the position; at other times, teachers of the biological sciences should be encouraged to prepare themselves for the work.

A method which especially commends itself to us is to combine this work with that in physical training. The teachers of physical training, of all the instructing staff of the school, stand in closest relation to the work of preservation and promotion of sound health. At present their work is somewhat narrow and suffers from the lack of any direct explanation of the principles of physical training. It would broaden the work of these teachers and make their present efforts more effective, if physiology and hygiene so obviously related to their other work were placed in their hands. True, it would require a broader preparation and an extension of the work of our normal schools of physical training in both time and scope; but this is really an argument in its favor. Normal schools of physical training ought to extend and enrich their courses, especially in view of the fact that so many of their graduates must occupy positions in the higher grades.

There is a widespread feeling that the present training in physiology and hygiene in the public schools is a failure. But signs are not lacking of a strong feeling among prominent educators that these subjects can and should rank in dignity and usefulness with languages, mathematics, physics, chemistry, biology, history and civics. Physiologists have long protested against the domination and excesses of 'temperance physiology.' Educators have complained of the bad pedagogical requirements often placed by law upon the teaching of the subject. We appeal to the members of the American Social Science Association to aid us in bringing about a reform, not as parties to either side of a dispute on questions of scientific fact about alcohol, nor from the standpoint of pedagogic theory and practice, but because the subject is one which profoundly affects social conditions and is closely related to a more intelligent and a more successful conduct of individual and social American life.

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Preliminary Report on the Marine Biological Survey Work Carried on by the Zoological Department of the University of California at San Diego.

The marine biological work of the Department of Zoology of the University of

California during the summer of 1901, with San Pedro, California, as a base of operations, was planned and carried out 'as though it were to be the beginning of a detailed biological survey of the coast of California.'*

That season dredging and trawling were the chief work. A large number of dredging stations at San Pedro, around Santa Catalina Islands and at San Diego were occupied, charted and their bearings recorded. Many hauls were made, several at each station, as far as possible. All the material secured was either preserved or in case of species so abundant as to make their preservation seriously burdensome, was recorded, quantitatively as far as practicable.

Owing to lack of funds, nothing was done during the summer of 1902 toward the survey work beyond some shore collecting at San Pedro. During the present summer the survey idea has been again foremost. It seemed this year, the total of circumstances being taken into consideration, that it would be best to devote attention to the plankton chiefly. A sail vessel could be used for this kind of work more advantageously than for dredging and trawling, and would be much cheaper and consequently would make the limited funds available go considerably farther. Two good, intelligent fishermen would be able to do nearly all the collecting alone, thus permitting the naturalists to devote their whole time to studying the material as it should be brought in. Again almost nothing had hitherto been done on the plankton of the waters of this region.

The laboratory was moved this summer from San Pedro to San Diego, or, more exactly, to Coronado. Several considerations brought about this removal. The most potent was the fact that a number of citizens of San Diego were desirous of having the work carried on there for a summer, at least, and were willing to furnish the funds to defray the expense of moving and of operating the station for six weeks during the summer and two weeks at the Christmas vacation, 1903–1904. Again, the zoologists of the university were glad of the opportunity to test more fully than had before been possible the fitness of the San Diego region as a location for a laboratory. Finally, the improvements of the harbor at San Pedro now being carried on by the national government, and the important commercial development in progress there, have made the building occupied as a laboratory inaccessible for this purpose, and have seriously, and, it is to be feared, permanently, impaired some of the most distinctive biological advantages of the location.

At Coronado ample quarters for a laboratory, well lighted and conveniently located, were generously given and partially fitted up by the Coronado Beach Company in their old boat house on Glorietta Bight. For a vessel the five- or six-ton schooner *Lura*, formerly a pilot boat of the port, was hired. This in charge of Mr. Manual Cabral, an unusually intelligent and competent fisherman, with a helper was kept constantly at the collecting, almost though not quite exclusively, of plankton.

The nets used were of Nos. 000, 12 and 20 miller's bolting. No closing net was employed, but a series of nets placed at intervals on a rope and hauled vertically was the means used to differentiate the depths at which the macroplankton was taken. For the comparatively shallow depths, not exceeding two hundred fathoms, to which the operations were limited, this method gives very good results. This is particularly true when there is but little wind or drift so that several hauls can be quickly made in nearly the same place. For collecting

* 'A Summer's Dredging on the Coast of Southern California,' SCIENCE, January 10, 1902, p. 55.

microplankton from different depths pumping was resorted to. For this a semi-rotary 'clock' force pump of one half inch intake and one half inch garden hose were used. This collecting was not extended below a little less than 100 fathoms. The volume of water that could be obtained by so small a pump and hose was too small to make the results wholly satisfactory. The trial convinced us, however, that the method is sound even for considerably greater depths than we were prepared to go, and that with a larger power pump and the right sort of a filter it would be of much importance. The most serious difficulty encountered during the summer was the lack of wind for propelling the schooner. Night collecting proved to be practically impossible most of the time on this account, and much of the time during the day the more sensitive organisms like some radiolarians, some medusæ, appendicularia, etc., were usually dead on reaching the laboratory when they were brought from a distance of six or eight miles.

The regular staff of the laboratory, *i. e.*, those engaged upon the survey work proper, with their tasks, were as follows: Wm. E. Ritter, Ph.D., professor of zoology, in charge, protochordata; C. A. Kofoid, Ph.D., assistant professor histology and embryology, protozoa; H. B. Torrey, Ph.D., instructor in zoology, cœlenterata; C. O. Esterly, A.B., assistant in zoology, copepoda; J. F. Bovard, B.S., assistant in zoology, protozoa, with Professor Kofoid; H. M. Evans, senior student in the university, hydrography and preparateur in zoology.

In addition the following persons used the laboratory for prosecuting their own special studies: Dr. A. Carlson, of the Leland Stanford Jr. University, investigations on the comparative physiology of the invertebrate heart; Mr. B. M. Davis, Los Angeles Normal School, investigations on the flotation of pelagic animals; Miss Marion Hubbard, of Wellesley College and the University of California, general studies on tunicata and mollusca; and Miss Margaret Henderson, a student of the University of California, special studies on the cœlenterates with Dr. Torrey.

SOME RESULTS.

No part of the summer's work was done with greater regularity and interest than the hydrographic, though only the temperature and the specific gravity of the water were attempted. About 150 determinations of each of these were recorded. This number is, of course, too small, particularly when confined to so limited an area and so brief a time, to have more than local significance. Even so, however, a few facts worthy of noting were brought out. It was found that the specific gravity of San Diego bay water was distinctly higher during the period of observation than that of ocean water, and that near the head of the bay it was higher than in the middle portion. The averages are: Ocean water, 1.02455+; bay water, middle portion (at Coronado), 1.02546+; upper portion (off National City), 1.02626+.

Although these results are what would be expected in view of the fact that San Diego Bay is a land-locked, comparatively shallow body of water, they are still of interest particularly because it has been surmised that a large subterranean inflow of fresh water from the San Diego River enters the bay at its upper end. While these observations do not disprove the conjecture, they obviously do not support it. Furthermore, the difference between ocean water and bay water was somewhat greater, on the average, at low tide than at high, the average differences being for low water, .001003+, and for high, .00087.

Another interesting but puzzling fact was

the sudden drop in both temperature and specific gravity of ocean water on July 27. Up to this time the average surface temperature at Coronado pier, taken at ten o'clock in the morning, had been about 20° C. On that date at the same hour of the day it was 16.2° C. This low temperature continued about three days, when the previous conditions were gradually resumed. The specific gravity fell distinctly though slightly with the temperature. These unusual temperature and density conditions were not associated with any special increase or change in direction of the wind or fall in atmospheric temperature, neither could they be with certainty correlated with any known tide or current movements.

Professor Kofoid reports as follows on the work done by him and Mr. Bovard on the protozoa:

Attention was confined almost wholly to the forms taken in the silk net on or near the 'bank' off Pt. Loma, and to a few catches nearer shore and in the bay. The plankton is very rich in the well-known pelagic groups Peridinidæ, Tintinnidæ and Radiolaria.

Of the *Peridinidæ* 59 forms were found. The list includes a number of varieties known only from the Bay of Naples, from Marseilles, the Red Sea and the Gulf of Aden, and includes many if not all of the well-known forms from the Atlantic and Mediterranean. The entire list is reported for the first time from this coast and most of them for the first time from the Pacific Ocean.

Of the *Tintinnidæ* 30 forms were observed, including several of unusual interest and importance. All of the species are listed for the first time from the Pacific Ocean, and many of them were known heretofore only from the Mediterranean, the Red Sea and the Gulf of Siam. Many Arctic and Atlantic species were also in the list.

The *Radiolaria*, though not abundant as to individuals, revealed a large number of species of which only a small part have as yet been carefully examined. Of the 33 studied a few are cosmopolites and most of them rare, known hitherto only from a single or at most a few specimens from *Challenger* collections in the tropical Atlantic and Pacific Oceans. One only was reported from the North Atlantic 57° N. latitude off Greenland, and others in hauls from great depths in mid Atlantic or Pacific, *e. g.*, in 2,250 fathoms or more.

Three pelagic Foraminifera which are cosmopolitan in the plankton occurred in the collections, and some bottom ooze cursorily examined appears to be rich in other forms which have not as yet been identified.

There were also four other forms belonging to other groups of protozoa, two ectoparasites on other pelagic organisms, one endoparasite and one flagellate free swimming in habit.

The affinities of the local protozoan fauna are to some extent with that of tropical waters, though some apparently northern forms appear in our lists. Apparently the protozoan fauna of the Bay of Naples, and perhaps that of the tropical Atlantic and Pacific, are to be found within a few hours' sail of San Diego.

Dr. Torrey's intimate knowledge of the actinozoa and hydroidea of the California coast enabled him to make the best of the little dredging and trawling and shore collecting done, and his preliminary report which follows, includes these as well as the pelagic groups:

The Cœlenterata are represented in the waters in the neighborhood of San Diego, Cal., by at least 86 species, more than half of which have not been found before in this region.

Among the medusæ, nineteen genera of craspedotes and one genus of acraspedotes have been taken, each represented by one species. Of these species, only four (*Aurelia labiata, Phialidium gregarium, Proboscidactyla flavicirrata, Thaumantias cellularia*) have been reported previously from this coast; three (*Cladonema radiatum, Tiara pileata, Tiaropsis diademata*) are known in the eastern United States or in Europe; of the remaining thirteen, seven are in all probability new to science.

Six species of Siphonophora, representing as many genera, have been collected. Two are old species, world-wide in their distribution (*Sphæronectes köllikeri, Diphyes appendiculata*). The others have not been closely identified, owing largely to their fragmentary condition; two are physonects, two cystonects.

Four species of Ctenophora, each representing a genus, have been collected. Two of these are well known north of San Francisco (*Pleurobrachia bachii, Beroe cyathina*). The third (*Mertensia* sp.) closely resembles the *M. ovata* of the eastern coast. The fourth is a lobate, which has appeared only in immature stages and can not be placed accurately until the adult form is known.

These floating forms were obtained by the tow-net at the surface and in vertical hauls from depths varying from thirty to one hundred and sixty fathoms. Some of the species were taken in almost every haul at whatever depth (*Diphyes appendiculata, Sphæronectes köllikeri, Glossocodon* sp., *Obelia* sp., *Mertensia* sp.). Most of them are represented by less than six individuals, some by but a single specimen.

On the shores of San Diego Bay, Point Loma, Coronado and the Coronado Islands, and in hauls of the dredge at depths varying from three to fifty fathoms, off Point Loma and in the mouth of the bay, there were obtained thirty species of hydroids representing fifteen genera, nine species of anemones representing six genera, two species of madrepore corals and five species of alcyonarian corals.

Of the thirty species of hydroids, at least four are new to science, eleven others have not been found here before, and two are new to the Pacific Coast. If to these thirty species there be added the fourteen previously reported but not obtained this season, the resulting total of forty-four will surpass the total known for any other region south of Puget Sound, and embraces representatives of nine of the eleven families known on the coast.

Of the nine anemones, all save one (*Sagartia* sp.) are found at San Pedro, two reaching beyond that point to the north, one to Puget Sound (*Epiactis prolifera*), the other to Santa Barbara (*Anthopleura californica*). All are peculiar to this coast.

None of the six corals are new species, but, so far as can be judged at present, are peculiar to the Pacific Coast.

Mr. Esterly summarizes the results of his study of the pelagic copepods as follows:

Twenty-seven species were recognized, of which twenty-two were accurately determined. These belonged to the following genera: *Acartia, Calanus, Euchirella, Heterochäta, Metridia, Oithona* and *Sapphirina*. Five of the twenty-seven species have not been reported previously outside the Mediterranean Sea. Four are new to North America.

The list of species obtained by the *Albatross* dredging on the west coast of South America and Mexico, and in the Gulf of California in 1891, contains forty-eight names. This number can now be increased by fourteen determined species, at least on the west coast of the Americas. Five of the species identified are common to this and the Woods Holl region on the Atlantic

coast. Considerable numbers of both males and females of a species undoubtedly new were found in San Diego Bay.

The tornaria described by me in 1893* was taken this summer for the first time since the original discovery. Only a few specimens were secured at Santa Catalina, its first locality. This year it was abundant during the whole period of our work. Its habits and structural changes during metamorphosis were consequently studied to good advantage. Furthermore, Mr. Davis found it a particularly interesting subject for his studies on the flotation, specific gravity and modes of locomotion of pelagic animals.

Nearly all the specimens taken were from nets that had been down to from thirty-five to ninety fathoms. Almost none occurred in surface towings. In spite of rather extensive experiments by both Mr. Davis and myself to determine the influence of light on the larva's movements, conclusive results were not obtained.

This tornaria is certainly closely related to, if not identical with, the Bimini larva figured by Morgan,† pl. I., fig. 12. In addition to this tornaria an occasional specimen of another species undoubtedly new to science and quite distinct, was found. This form is especially characterized by the possession of as high as seven pairs of branchial pockets before there are other obvious signs of metamorphosis.

Of the pelagic tunicata, only the genus *Oikopleura* representing the Larvacea has yet been taken on the coast of California. Apparently two species of this genus occurred rather abundantly in the tow throughout the summer. The extreme sensitiveness of these animals to removal from the sea itself is a striking phenomenon in the ecology of pelagic organisms and richly deserves investigation.

But a single species of *Doliolum* was taken, and that represented only by the 'nurse'; but this species is particularly interesting, it being clearly the peculiar form hitherto known only from the specimens taken by the *Challenger* and described by Herdman in his report on the pelagic tunicata of the expedition.

Of the seven or eight species of *Salpa* now known from the California coast only five were found during the summer; of these, however, one was taken for the first time, and is a new species. *S. runcinata-fusiformis* was by far the most abundant species.

Pyrosoma atlanticum var. *tuberculosum* was taken in considerable numbers, and is the first record of a member of this genus on our coast so far as our collecting is concerned.

Owing to the little dredging and trawling and shore collecting that were done, only about fifteen species of sedentary ascidians were obtained. The great abundance of *Ciona intestinalis* on the floats and piles of the laboratory is worthy of mention as showing the ease with which this species may be obtained in unlimited quantity for experimental or morphological studies.

A wealth of life representing other subdivisions of the animal kingdom came to the laboratory, but, owing to a lack of workers, could only be admiringly looked at and put into preserving fluids to await attention in the future.

Mention should be made of the fact that the species of *Gonyaulax* which appeared in such enormous numbers in the summer of 1901,* occurred at San Diego this year

* 'On a New Balanoglossus Larva from the Coast of California, etc.,' *Zool. Anz.*, XVII. Jahrg., 1894, p. 24.

† 'The Development of Tornaria,' *Journ. of Morph.*, Vol. IX., p. 1.

* H. B. Torrey, 'An Unusual Occurrence of Dinoflagelata on the California Coast,' *Amer. Naturalist*, Vol. 36, March, 1902. Also W. E. Ritter, 'A Summer's Dredging on the Coast of Southern California,' SCIENCE, January 10, 1902.

quite as abundantly as it did that year at San Pedro. During the last days of July the water of the ocean at Coronado extending from the shore out to a mile or more took on the rusty color, increasing at times and in places to almost that of old blood clot, with which we became so familiar at San Pedro two years ago. This year, however, we observed nothing of the fatality among other animals, as an accompaniment of the visitation, that occurred in 1901. It is not certain, however, that this latter phenomenon was absent, for we did not have the same opportunities for observation this year that we had before. This year we did no dredging in the affected region and consequently had no chance to see how the bottom organisms were affected. Furthermore, there was no high wind this year to drive the *Gonyaulax* on to the shore and to cast up the dead of other animals, had they existed.

As mentioned above, the same kind of work will be carried on again for two weeks during the Christmas recess of the university. This much we are now able to do toward realizing the plan of distributing the survey operations throughout the year.

It gives me genuine pleasure to conclude with an acknowledgment of our obligations to the citizens of San Diego for having made the work possible this year. The whole expense of moving the laboratory from San Pedro and of fitting up the new one at Coronado, and likewise all the expense of carrying on the work excepting for the equipment that was taken from the university, was provided by the citizens. A committee of the chamber of commerce of that city had the matter in charge, and such a duty was certainly never more efficiently discharged by any similar body of men.

Wm. E. Ritter.

University of California,
August 14, 1903.

SCIENTIFIC BOOKS.

THE COLLECTED PAPERS OF ROWLAND AND FITZGERALD.

The Physical Papers of Henry Augustus Rowland. Collected for publication by a Committee of the Faculty of the University. Baltimore, The Johns Hopkins Press. 1902. 8vo. Pp. xi + 704.

The Scientific Writings of the Late George Francis FitzGerald. Collected and edited with a historical introduction by Joseph Larmor. Dublin University Press Series. Dublin, Hodges, Figgis & Co., Ltd.; London, Longmans, Green & Co. 1902. 8vo. Pp. lxiv + 576.

No more fitting memorials could have been produced in honor of the two distinguished physicists, whose untimely deaths occurred in the early months of 1901, than these admirable volumes issued by the Johns Hopkins Press and by the Dublin University Press respectively. The first duty of the living, therefore, is to acknowledge our deep indebtedness to Professor Ames and to Professor Larmor on whom the burden of the work fell in collecting and editing these widely scattered papers and in bringing them into readily accessible forms in the short space of two years. They have thus at once rendered homage to the heroes who have gone before and encouragement to the hosts who follow in the arduous march of physical science. The desirability of republication of the scattered papers of eminent men of science is now pretty generally recognized, and the prompt issue of the papers of Rowland and FitzGerald sets an example which should be widely followed.

The nearly simultaneous appearance of these two volumes tends to emphasize a remarkable similarity in the careers of Rowland and FitzGerald. Each was the son of a clergyman; each was a physicist by nature in spite of all educational influences that might have led his thoughts along other lines; each was in the van of the great progress in physical science of the last thirty years; each was a vigorous champion of the laboratory method in scientific studies; each advocated in the strongest terms the merits of pure re-

search; and each sacrificed himself, we might almost say, in his unflagging efforts for the advancement of science.

The appearance of the volumes recalls attention, also, to the singular fatality which has prevailed in the ranks of the leaders in electro-magnetic science. Maxwell, Hertz, FitzGerald and Rowland all fell while yet in the prime of life. Were they victims to overwork, or did they sap their vitality in their early struggles for the recognition essential to secure them the means of subsistence? Possibly there is more truth than poetry in Rowland's question in his address on 'The Highest Aims of the Physicist'—'Where can the discoverer in science earn more than the wages of a day laborer or cook?' No doubt each of them had to do combat with many obstacles other than those which nature sets up in the way of learning her laws, for society does not appear to have discovered any method as yet to prevent the waste of effort involved in surmounting such obstacles. Society, indeed, seems to be almost wholly unconscious of the value to itself of its most important members. Our best known and most applauded heroes of state are still those who win renown by shedding human blood. Nevertheless, Rowland and FitzGerald lived during a period of great progress toward a higher civilization than that into which they were born. Each of them contributed nobly and effectively to that progress, and the scientific world, at least, gave them its heartiest encomiums.

As indicated by the title, the volume of Rowland's papers contains reprints only of those devoted especially to physical subjects, although the bibliography included in the work embraces all of his published papers. The preface and table of contents of the volume are followed by the capital commemorative address of Dr. Mendenhall, read before an assembly of friends at Baltimore, October 26, 1901. The many interesting facts and incidents from Rowland's career related in this address would tempt one to quote freely from it if it had not been published already in this journal.*

* 'Henry Augustus Rowland': T. C. Mendenhall. SCIENCE, N. S., December 6, 1901. Pp. 865–877.

The papers are arranged in groups under the following heads: Part I., 'Early Papers'; Part II., 'Magnetism and Electricity'; Part III., 'Heat'; Part IV., 'Light.' Then follow a list of addresses, six in number; a full bibliography, embracing 72 titles; and a description, with suitable plates, of the dividing engines devised by Professor Rowland. The latter description and plates were prepared by Professor Ames, Professor Rowland having left no records with respect to these machines.

Two lifelike portraits of Professor Rowland are included in the volume; and it is hardly necessary to add that so fine a memorial and so good a specimen of book-making is supplemented by an adequate index.

The text of FitzGerald's papers is preceded by a most interesting and instructive account of his life drawn from communications to the *Electrician* and to the 'Obituary Notices of the Royal Society' by Principal O. J. Lodge; to *Nature* by Dr. Larmor; to the *Proceedings of the Institution of Electrical Engineers* by Professor F. T. Trouton, and to the *Physical Review;* embracing in all pp. xx–lxiv. These reveal not only a man of remarkable originality and versatility in science, but a man also of the gentlest and broadest sympathies. Few men in any sphere of intellectual activity have been so generally esteemed with affectionate regard by their contemporaries.

The papers are arranged in the chronological order of their first publication. There are 108 of them, the first having been published in 1876. They touch a wide range of subjects, and although some of them are condensed to the merest abstracts they are generally bristling with clear ideas and fruitful suggestions.

Amongst the most useful as well as most interesting of these writings are his reviews and semi-popular addresses. The latter, especially, deserve to be widely read, since they are luminous with the spirit of progress of our age, not only for the small number of scientific specialists but for the whole human race. In what he has to say about 'Universities and Research,' No. 60, 'Science and Industry,' No. 77, 'Lord Kelvin's Researches,' No. 78, 'The Applications of Science,' No. 95,

he proves himself a prophet and a statesman in the best senses of the words, as well as an eminent representative of natural philosophy.

The editor has properly anticipated that the volume will be much consulted, and he has supplied an index which will prove particularly useful to those not already acquainted with the scope of importance of FitzGerald's writings. An excellent portrait accompanies the volume as a frontispiece.

R. S. W.

Lehrbuch der vergleichenden Anatomie. By B. Haller. Erste Lieferung. Jena, Gustav Fischer. 1902.

This book, the first portion of which is here considered, is intended by the author to fill the gap left vacant by the aging of Gegenbaur's 'Grundriss der vergleichenden Anatomie,' a book familiar enough to the older generation of zoologists, but now almost unknown, its last edition having appeared some twenty-five years ago.

The 'Grundriss' was what its title denotes, a comparative anatomy as contrasted with a zoology, or, in other words, a concise exposition of the various systems of organs in their modifications and adaptations throughout the animal kingdom, rather than a description of the morphological characteristics of the various classes of animals. That such a book, brought up to date, would fill a gap in our zoological literature there can be no doubt, but that the volume before us does so is more than questionable. For it is a compromise; it is a zoology as far as its general plan is concerned, and a comparative anatomy only so far as each great zoological group is concerned. Its plan is essentially the same as that of Lang's 'Lehrbuch,' though on a less extensive scale, and because it is less detailed the defects of the plan are all the more pronounced.

And even more to be criticized is the classification which has been adopted for the achordata, which alone are treated in the portion of the book before us. The recognition of a group Vermes, including the platyhelminths, nemathelminths, rotifera, chætognaths and annelids, and a group Arthropoda including crustaceans, arachnids, protracheates and tracheates as of equal value with a group Bryozoa and a group Brachiopoda, not only indicates a depressing lack of taxonomic perspective but leads the student to erroneous conceptions of the affinities of the invertebrate phyla, thereby depreciating one of the prime values of comparative anatomy.

The contents of the book, apart from these general defects, are on the whole good and cover the proposed ground as completely as could well be expected within the limits set. They may, however, be criticized for a lack of clearness, attributable to a certain extent to the unfortunate arrangement of topics and for occasional errors of statements. Among the latter may be mentioned the description of the mesenterial filaments of the Anthozoa as 'finger-shaped processes' arising from the edges of the mesenteries, an error repeated in the figure illustrating the structure of an Anthozoan, and the rather scant reference to the coxal glands of the Xiphosura and arachnids as integumental organs.

The figures are numerous and on the whole well chosen and admirably reproduced. The text, however, awakens wonderment by the extraordinary number of typographical errors which it contains. The technical terms offend especially in this respect, though by no means exclusively, and though it would be an exaggeration to say that an error occurs on almost every other page, one cannot help wondering how the proof-readers could have allowed so many flagrant errors to escape notice. Achorodaten (Achordaten), Hiozoen (Heliozoen), Mikrocoma, Hyppocrane (Hippocrene) and Pachyrchina are hardly recognizable in such novel guises and *Paramœcium* masquerades as *Paramætium*, *Parametium* and *Paramætium*. But disturbing as these examples may be, it gives one an actual shock to find *Loxosoma* quoted as a multinucleated infusorium, *Idotea* as an opisthobranch mollusk, and after reading a paragraph concerning the Phronimidæ to discover that the author is really talking about the Phoronidæ. There is probably an explanation for such remarkable errors, but there cannot be a valid excuse for them.

With all these defects the book is hardly one to be recommended to the young student. It would almost be better for him to hunt up the time-honored 'Grundriss.'

J. P. McM.

SOCIETIES AND ACADEMIES.

THE AMERICAN POMOLOGICAL SOCIETY.

THE American Pomological Society held its twenty-eighth bienniel meeting at Boston on September 10, 11 and 12. Among the papers on the program were, in addition to the address of the president, Professor Charles Watrous, of Des Moines, Ia., the following:

DR. L. H. BAILEY, Cornell University, Ithaca, N. Y.: 'The Attitude of the Schools to Country Life.'

MR. J. HORACE MCFARLAND, Harrisburg, Pa.: 'Fruit Gardens, what they are and what they are for.'

PROFESSOR S. B. GREEN, St. Anthony Falls, Minnesota: 'Hardy Fruit Gardens.'

PROFESSOR E. J. WICKSON, University of California, Berkeley, Cal.: 'Fruit Gardens of the Pacific Coast.'

MR. G. HAROLD POWELL, pomologist in charge fruit storage investigations, U. S. Department of Agriculture: 'Relation of Cold Storage to Commercial Orcharding.'

DR. C. L. MARLATT, first assistant entomologist, U. S. Department of Agriculture: 'The San Jose Scale in the Orient.' (Illustrated.)

HON. W. A. MCKINNON, chief of Fruit Division, Department of Agriculture, Ottawa, Canada: 'Fruit Inspection and the Export Trade.'

MR. GEO. T. POWELL, Ghent, N. Y.: 'Should the Commercial Grower Plant Varieties of High Quality?'

DR. W. D. BIGELOW, acting chief, Bureau of Chemistry, U. S. Department of Agriculture: 'Pure Food Legislation and its Relation to the Fruit Grower.'

PROFESSOR F. W. TAYLOR, chief, Department of Horticulture, St. Louis, Mo.: 'Pomology at the St. Louis World's Fair.'

DISCUSSION AND CORRESPONDENCE.

THE BAHAMAS VS. TORTUGAS AS A STATION FOR RESEARCH IN MARINE ZOOLOGY.

FROM June 4 to July 27 the writer was in charge of an expedition of the Museum of the Brooklyn Institute of Arts and Sciences which had for its object the study of the coral reefs and marine zoology of the Bahamas. The writer had already enjoyed the privilege of studying the marine zoology of the Bahamas during the winter months while acting as assistant to Dr. Alexander Agassiz upon the *Wild Duck* expedition of 1892–93.

Having now seen the conditions in the Bahamas in summer as well as in winter, the writer feels justified in drawing a comparison between this region and that of the Tortugas in reference to their comparative advantages as stations for the establishment of a laboratory for research in marine zoology.

Nassau, the capital of the Bahamas, is a clean, healthful city attractively situated upon hills of *æolian* rock and possessed of a good harbor.

The social conditions commonly found in English colonies are here well developed, and one meets with gracious treatment both from the government officials and from the residents of the islands. It is certain that were a laboratory for research in marine biology to be established in the Bahamas, under good auspices, the community would extend a cordial welcome to the investigators and render their sojourn in the colony pleasant in every way.

The harbor of Nassau is a long, narrow trough bordered on the south by the island of New Providence and on the north by Hog and Rose islands. A very strong tidal current sets through it, flowing eastward with the flood and westward with the ebb-tide, the current being of such strength that it is necessary only to anchor in the tide-way and throw over a tow-net in order to make a surface haul under ideal conditions. This is an advantage possessed by but few localities and would enable a laboratory to supply itself with a practically continuous surface haul.

Unfortunately, however, the surface hauls are very poor in comparison with those from the Tortugas. The prevailing winds in the Bahamas during the summer are from an easterly direction, and these drive the surface water into Nassau harbor from over the shallow flats which extend for about seventy-five miles between New Providence and Eleuthera

island. In common with most of the Bahama banks these shallow flats are veritable submarine deserts. Here and there one finds a small cluster of coral heads and gorgonians, but almost everywhere the bottom is a flat barren waste of sand supporting a sparse growth of coralline algæ. Not only is the bottom deficient in living forms, but the pelagic life in the water over these flats is poor to an even more marked degree both in number and variety of forms. This water is more or less charged with a flocculent mass of finely divided mud similar to that commonly met with off the mainland coast of Florida, and evidently churned up by the currents caused by winds and tides. This floating material clings readily to pelagic animals and plants and appears to be rapidly fatal to the majority of pelagic creatures. Among medusæ only a few species allied to *Gonionemus* appear to thrive in this water of the Bahama banks.

Almost no Sagittæ or Salpæ and remarkably few Crustacea or Medusæ are found in the water of the shallow banks, whereas these forms are abundant over the Tongue of the Ocean where the depth varies from 500 to 1,000 fathoms, and to the northward of New Providence Island in water 1,500 to 2,000 fathoms deep. Indeed, whenever the wind becomes reversed and comes from a westerly direction the pelagic hauls in Nassau harbor become rich in truly oceanic forms which have evidently drifted in from the Tongue of the Ocean.

An idea of the relative poverty of the pelagic fauna of the Bahamas as compared with that of the Tortugas will become apparent from the fact that the most assiduous efforts in surface hauls at the Bahamas brought to light only 43 species of medusæ, while 90 species were found by the writer at the Tortugas. The writer once drew a large surface net for three miles through the most promising looking 'slick' over the bank without capturing a single marine animal.

The coral reefs of the Bahamas are richer than those of the Tortugas where the corals were largely killed twenty-four years ago by a sudden influx of 'poisoned' water apparently from the mainland of Florida.

A wonderful reef, rich especially in *Madrepora, Agaricia, Dendrogyra* and Gorgonians stretches along almost the entire eastern shore of Andros Island. At New Providence Island also one finds a remarkable reef abounding in *Porites, Mœandrina, Madrepora palmata* and Gorgonians off Clifton Point, while another cluster especially rich in *Mœandrina* and *Orbicella* lies off the eastern point of New Providence. There are also good reefs within Nassau harbor, and, indeed, the expedition met with remarkable success in its collection of corals, obtaining some of the largest and most perfect stocks ever taken from the West Indian region.

In comparison with that of the Tortugas reefs the fish fauna of the Bahamas is markedly poor. It is evident also that the invertebrates are not so abundant among the Bahamas corals as they are among those of the Tortugas. This, however, does not apply to the Actinians, which are more numerous in both number and variety than at the Tortugas.

The Bahama region is richer in corals, poorer in fishes and invertebrates, and far poorer in pelagic life than that of the Tortugas. Indeed, as Bigelow aptly states, the Bahamas lie upon the wrong side of the Gulf Stream. In this respect the situation of the Tortugas is almost ideal, for they are surrounded by the purest of ocean water, and the prevailing winds, both in summer and winter, drift upon their shores the rich pelagic life of the Gulf Stream.

It is true that the Tortugas afford practically no opportunity for the study of land fauna or flora, but there is no place known to the writer in the American Tropics where both land and marine faunæ are exceptionally rich. For the study of marine life we must seek the borders of the Gulf Stream.

In considering the question of the establishment of a laboratory for research in marine zoology we must, I think, confine ourselves to the problem of the study of the ocean and leave that of the study of the land fauna to

another laboratory especially designed for such a purpose.

In recent discussions in SCIENCE it is apparent that some of the correspondents were ignorant of the conditions which have prevailed since 1898 at the Tortugas.

The station is now a naval coaling base and a large and comfortable tug makes regular trips twice a week to and fro between the Tortugas and Key West, leaving at 8 A.M. and arriving at about 2 P.M. Even during the writer's earliest visits to the region it was never necessary to charter a vessel in order to proceed from Key West to the Tortugas, as has been implied by one of the correspondents.

The climate of the Tortugas is cooler than that of the Bahamas, owing to their smaller land mass and the refreshing influence of the ocean breeze. In both Bahamas and Tortugas the breezes throughout the months of May to August are usually so gentle that one may make studies of the windward sides of the reefs on almost any day, using very small rowboats. The yellow fever quarantine station was abolished at the Tortugas in 1899, and there are practically no mosquitoes on Loggerhead or Bird Keys.

Although the community at the Tortugas is small the social conditions are pleasant, for people of culture and education are sure to be found among the naval officers and their families, and indeed, the writer recalls with keen pleasure many most enjoyable hours spent in company with one of the keepers of the lighthouse. The community is sufficiently small not to distract, but yet large enough to render pleasant and profitable the few leisure hours which may be enjoyed by one engaged in marine research. The Tortugas is in telegraphic connection with Key West, and a naval surgeon is stationed at Fort Jefferson.

ALFRED GOLDSBOROUGH MAYER.

SHORTER ARTICLES.

THE BRAIN-WEIGHT OF THE JAPANESE.

INVESTIGATIONS concerning the weight of the brain in the non-European races have hitherto been exceedingly limited. All that was known of the brain-weight of the Japanese was confined to a few statistics reported by Doenitz* (1874), Taguchi† (1881) and Suzuki‡ (1892), comprising in all 130 brains. These were nearly all of persons who were decapitated in the time of the 'Meiji.' The average brain-weight of 100 males was found by Taguchi to be 1,356 gms.; while Doenitz gives 1,337 gms. for 10 male subjects. Professor K. Taguchi,§

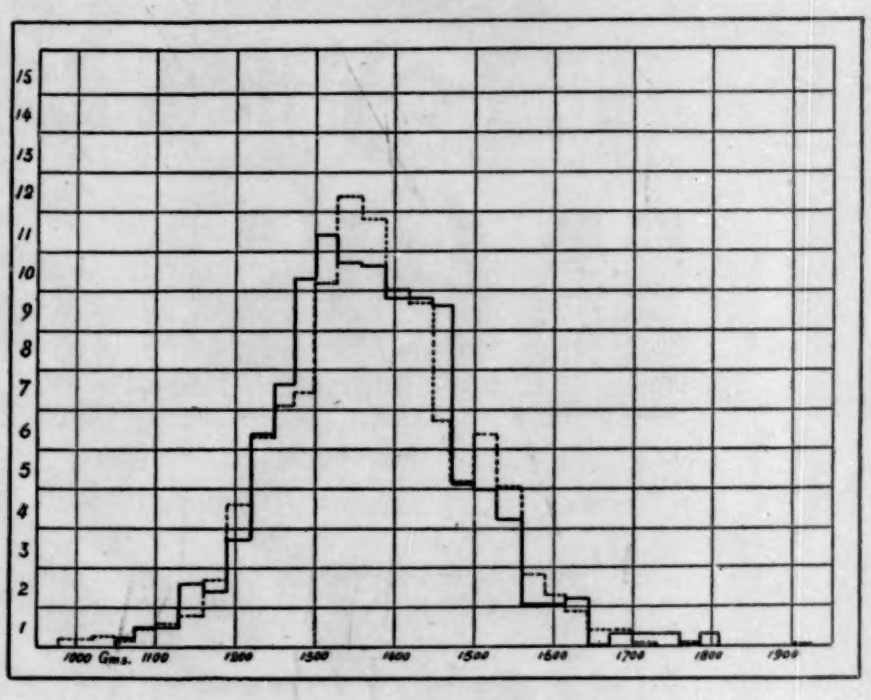

FIG. 1. Chart showing distribution of 374 male Japanese brain-weights (continuous line) as compared with 1,012 German brain-weights (broken line) of the Bischoff-Marchand series. For convenience in comparison, both series are tabulated on a basis of 100 cases each.

of Tokyo University, recognizing the need of fuller statistics, began ten years ago to record systematically brain-weights together with data concerning stature, age and body-weight. His researches are based upon 597 subjects; 421 males and 176 females, mostly from the hospitals. The average brain-weight of 374

* Doenitz, 'Mitth. d. deutsch. Gesellsch. f. Natur. u. Völkerk, de Ostasiens,' Yokohama, 1874.

† 'Kaiboranyo,' Vol., 1881, p. 18.

‡ *Tokyo Medical Gazette*, VI., 1892, p. 518.

§ K. Taguchi, 'On the Weight of the Encephalon of the Japanese,' *Sei-I-Kwai Medical Journal*, Tokyo, Vol. XXII., Nos. 1, 2 and 3, 1903. Also in *Neurologia*, Vol. I., No. 5, 1903.

adult males (ages 21–95) is 1,367 gms. (max. = 1,790; min. = 1,063); of 150 adult females it is 1,214 gms. (max. = 1,432; min. = 961). The sexual difference of these averages is 153 gms., about the same as in Europeans.

TABLE I.

Males.

Age.	Japanese. (Taguchi) (397).	Germans. (Bischoff) (545).	Germans. (Marchand) (493).	Russians. (Giltschenko) 720.	Swedes. (Retzius) 350.	Czechs. (Matiegka) 306.
14–20	1,345	1,340	1,404	1,413	.....	.....
20–30	1,350	1,396	1,416	1,394	1,434	1,475
30–40	1,374	1,365	1,391	1,358	1,412	1,467
40–50	1,391	1,366	1,403	1,345	1,388	1,423
50–60	1,389	1,375	1,370	1,347	1,392	1,445
60–70	1,381	1,323	1,370	1,267	1,349	1,419
70–80	1,333	1,279	1,324	1,284	1,340	1,367
80 and over.	1,342			1,289		1,442

Females.

	(156)	(341)	(266)	( )	(250)	(205)
14–20	1,226	1,242	.....	.....	.....	.....
20–30	1,264	1,234	1,293	.....	1,279	1,309
30–40	1,210	1,233	1,267	.....	1,268	1,332
40–50	1,179	1,240	1,260	.....	1,246	1,298
50–60	1,252	1,200	1,260	.....	1,237	1,266
60–70	1,219	1,178	1,215	.....	1,244	1,245
70–80	1,202	1,121	1,159	.....	1,195	1,242
80 and over.	1,102			.....		1,189

In order to better understand the distribution of these brain-weights as compared with those of Europeans, the writer has employed Taguchi's figures in the preparation of the accompanying chart (Fig. 1). The distribution of the (374) male Japanese brain-weights (continuous line) is seen to correspond fairly well with that of (1,012) male German brain-weights (broken line) of the Bischoff-Marchand* series. The comparison can be fairly made, since the weighings were made according to similar methods in both series.

Taguchi has no records of the weight of the brain in the new-born, but has 156 brain-weights of children ranging from two months to fourteen years of age. Comparing these with similar records of European children (Pfister, Mies, Marchand), it is evident that the growth of the Japanese brain is slower. The brain of the Japanese boy between nine and fourteen years of age weighs about 1,235 gms., while that of the European of the same age weighs 1,300–1,350 gms. Among adults there is a gradual increase up to the fifth decade. Table I. shows the weight of the brain in the various decades in comparison with those of Germans (Bischoff and Marchand), Swedes (Retzius), Czechs (Matiegka) and Russians (Giltschenko). The maximum is attained in the fifth decade among the Japanese males; in the female series two maxima occur, one in the third, the other in the sixth decade. The necessity of obtaining still more extensive statistics is, therefore, apparent.

The relation between brain-weight and stature is as positive as is observed in the European series. The Japanese are a people of small stature, however, and this fact lends interest to the question of relative brain-weight. It is a little difficult to institute very satisfactory comparisons with the European records since Taguchi's methods of tabulation are different from those generally employed. The following table may help the reader to interpret the relations of brain-weight and stature among Europeans (Germans, Russians and Czechs) and in the Japanese series.

TABLE II.

Males.

Japanese. Stature.	Japanese. (226.)	Stature.	Marchand (439).	Bischoff (390).	Giltschenko (720).	Matiegka (269).
138–148	1,324	145–150	.....	1,307	1,342	.....
148–158	1,355*	151–160	1,360	1,339		1,403
158–168	1,380	160–164	1,388	1,341	1,359	1,417
		165–170		1,355	1,375	1,430
		171–180	1,404	1,389	1,404	1,457
		180 and over.		1,375		1,496

* See the writer's review of Marchand's 'Ueber das Hirngewicht des Menschen,' SCIENCE, N. S., Vol. XVII., 1903, p. 345.

* In the original this figure is given as 1,535 gms. This is manifestly a typographical error; it should be 1,335 or 1,355 instead. The latter figure is more likely to be correct.

Another mode of interpreting these results is to calculate the number of grams of brain-weight per centimeter of stature (Table III.). This shows that the relative brain-weight is about the same in the races mentioned and only in the very small Japanese individuals is the ratio high. The small stature of these people is therefore more characteristic of the race than is the absolute brain-weight.

TABLE III.

Males.

Grams per Centimeter of Stature.

	Germans.		Russians.	Czechs.	Japanese.
Less than 150 cm.	Bischoff.	Marchand.	Giltsch'-ko.	Matiegka.	Taguchi.
150	8.7	9.2			9.3
155			8.6	9.0	8.7
160	8.3	8.4			
165	8.1	8.2	8.4	8.6	8.5
170	7.9	7.9			
175	7.6	7.8	7.9	8.3	
180		7.8			
185				8.1	
190	7.1	7.8			

As regards the relation of brain-weight and body-weight there are bound to be great diversities of opinion as to the average ratio. Bischoff's ratio is 1:36.6 in males, 1:35.2 in females. Vierordt's more extensive tables give 1:46.3 in males, 1:44.8 in females. Taguchi finds 1:38.3 and 1:42.9 respectively in his Japanese series. The weight of the body is, however, a very unsatisfactory standard for comparison since the mode of death and other factors exert a great influence upon it. Such objections can not be raised against employing the stature as a basis for estimating relative brain-weight.

To recapitulate, the brain of the Japanese grows more slowly during infancy and early youth than it does in the European. In the adult the brain-weight compares favorably with that of Europeans of similar stature and it may be shown to be superior in this respect to other races of the same general stature. These facts are of not a little significance in relation to the learning, industry and aptitudes of this progressive race.

E. A. SPITZKA.

GONIONEMUS VERSUS 'GONIONEMA.'

WITH the growing multiplicity of names in zoological nomenclature and their great similarity, although referring to widely different forms, it is certainly a questionable practice to change the name of any animal unless there is urgent reason for doing so.

It is well known that names of animals are not all good etymology or derivation, but this should not be sufficient ground for changes. A name once given an animal by proper authority is its name irrespective of etymology or its significance, and would better not be changed in most cases for any less reason than being preoccupied.

As *Gonionemus* is a jellyfish that will be frequently referred to, on account of its being used both in many experiments and in universities and colleges for class study, it is desirable to have the form of its name established.

Haeckel ('System der Medusen') first changed Agassiz's naming of the genus to '*Gonynema,*' because he supposed the name was intended to mean 'kneed thread.' And in the light of Agassiz's description ('North Am. Acalephæ,' 1865), in which he said '* * * the moment a blade of kelp touches their disc, they stop, bend their tentacles *like knees,* and remain attached to the seaweed * * *,' it is evident that he meant to use for part of the name the word that refers to knees. If the name were to be changed, therefore, it should be *Gonynema,* which would also be correct in construction.

The form of the name '*Gonionema*' was first published by Yerkes (*Am. Jour. of Physiol.,* Vol. VII., No. 2) and since then used by others, but here again only the ending is corrected and it still remains to change the end of the first part, making it *Gonianema.** Dr. Perkins (*The Proc. of the Acad. of Nat.*

* Since the above was put into type a letter from Professor Agassiz states that, in 1859, in making the name Gonionemus he meant to suggest 'something with knees browsing about in the huge kelp,' which reminded him of a grove. According to this, then, the part of the name in question is from '*nemus*' and the original ending is the proper one.

Sciences, Phila., March 7, 1903) in his interesting paper on 'The Development of *Gonionema*' first gives the authority of Agassiz approving the correction, but in view of the confusion that might arise I propose to retain the name *Gonionemus*, originally given the genus by Professor Agassiz, and would like to urge that future writers use this form.

L. Murbach.

Detroit, Mich.

BOTANICAL NOTES.

MOSSES.

Dr. A. J. Grout has just published 'Mosses with Hand-Lens and Microscope, Part I.,' as a quarto pamphlet of 86 pages. This is a 'non-technical hand-book, of the more common mosses of northeastern United States,' and is the outgrowth of 'Mosses with a Hand-Lens,' published by the same author a few years ago.

After a brief introduction, chapters are given dealing with classification and nomenclature, collection and preservation, mounting and methods of manipulation. The life history and structure of the moss plant are then given in some detail. Since the peristome is of considerable importance in indicating the relationships of mosses, the discussion of its structure is given due prominence in this section. An illustrated glossary of bryological terms constitutes a valuable feature of the work.

After listing the more important works on mosses for American students, the author takes up the systematic study of the more common forms. The key to the families is followed by the treatment of the Sphagnaceæ, Andreaceæ, Georgiaceæ, Polytrichaceæ, Buxbaumiaceæ, Fissidentaceæ and Dicranaceæ in part, leaving the remainder of the twenty-seven families recognized for treatment in subsequent parts (four to five parts in all will be issued). The classification adopted does not deviate very much from that given in Dixon and Jameson's 'Hand-book of British Mosses.' In the matter of changes in nomenclature the author has been quite conservative.

The work is illustrated with a considerable number of figures in the text, besides ten full-page plates. The fact that the latter are reproductions from 'Recherches sur Les Mousses,' by Schimper, 'Bryologia Europea,' and Sullivant's 'Icones Muscorum' is sufficient guarantee for their excellence. The purpose of the work is best given in the words of the author: 'To give by drawings and descriptions the information necessary to enable any one interested to become acquainted with the more common mosses with the least possible outlay of time, patience and money,' but we doubt if the author's prediction, 'that it makes the mosses as easy to study as the flowering plants,' will ever be realized. The beginning student will find Dr. Grout's publication a very valuable aid, and by those who do not have the more exhaustive treatises at their command it will be especially prized.

MORPHOLOGY OF ANGIOSPERMS.

Students of morphology will welcome the appearance of 'Morphology of Angiosperms,' by Dr. J. M. Coulter and Dr. Chas. J. Chamberlain, from the press of D. Appleton & Co. It is worthy of note that this work is not issued as Part II. of the 'Morphology of Spermatophytes,' as was the intention when its companion volume dealing with the Gymnosperms was published in 1901. This may be taken as a protest against considering the Spermatophytes as a group coordinate with the Pteridophytes.

The present volume, to use the authors' words, "Has grown out of a course of lectures accompanied by laboratory work, given for several successive years, to classes of graduate students preparing for research. It seeks to organize the vast amount of scattered material so that it may be available in compact and related form." After a brief introduction the following sequence of chapters is taken up: The flower, the microsporangium, the megasporangium, the female gametophyte, the male gametophyte, fertilization, the endosperm, the embryo. The chapter on the microsporangium ends with the formation of the mother-cells, and with their division the history of the male gametophyte is entered.

This line of separation is supported by the arguments of Strasburger, but even Strasburger has been known to change his opinions. To begin the gametophyte with the germinating spore certainly gives us a much clearer conception of the alternation of generations.

The history of the megasporangium is likewise terminated by the formation of the mother-cells, for their division is a reduction division, which is used as the basis of separation of sporophyte and gametophyte.

In the history of the male gametophyte the view that the tube-cell is the antheridium wall that develops a tubular outgrowth, 'while the generative cell and its products is the spermatogenous part of the antheridium' is given the preference. A careful reading of the chapter on the female gametophyte shows that the germination of the megaspore and formation of the gametophyte is not such a uniform process as most of our standard texts describe. In dealing with fertilization, 'double fertilization' is given due prominence, and the authors object to the use of the term as they consider it far from established that a real fertilization takes place; hence they prefer to speak of it as 'triple fusion.' The disputed centrosome question is touched upon and the authors' views may perhaps be gained from the following quotation: 'To say that all the figures that have been drawn have been mere products of the imagination would be a radical statement and one doubtless very far from the truth.' In the discussion of the endosperm its morphological character is touched upon, and while its exact nature is not considered established, the view that it is 'belated vegetative tissue of the female gametophyte, stimulated in a general way to develop by the act of fertilization,' is held as the most probable, although the possibility that it is a second sporophyte is admitted. Parthenogenesis and polyembryony are treated in the chapter on the embryo, and recent investigations seem to indicate that both are much more common than was formerly supposed.

In connection with each chapter there is a bibliography of the most important literature. An idea of the number of original papers consulted may be gained from the literature cited in the chapter on the female gametophyte, which includes 122 separate articles. The masterly way in which the vast amount of chaotic material has been handled is a commendable feature of the work, and we are inclined to think that the authors of some of our standard texts might consult it with profit.

Several chapters are given on classification, and it is encouraging to note that the authors have not found it necessary to develop a classification of their own but have been contented to adopt the classification of Engler and Prantl as given in 'Die Naturlichen Pflanzenfamilien,' as 'the best expression of our present knowledge, as applied to the whole of the Angiosperms.' The fact that 'this has not been pressed to the dreary details of minor groups,' but that general principles have been emphasized, makes these chapters of special value to the morphologist.

Separate chapters are given to geographic distribution, fossil Angiosperms and phylogeny of Angiosperms. The work closes with two chapters on the comparative anatomy of Gymnosperms and Angiosperms contributed by Professor E. C. Jeffrey, of Harvard University. Only a brief outline of the subject is attempted and perhaps some students will feel that a more extended treatment would have been advisable.

The whole work is illustrated with something over a hundred figures taken in large part from the original articles cited. The book is an admirable presentation of the subject and should be in the hands of every working botanist.

F. D. HEALD.

UNIVERSITY OF NEBRASKA.

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*INVESTIGATIONS IN PROGRESS AT THE UNIVERSITY OF CHICAGO.**

IN a former Convocation Statement I endeavored to point out in a general way that the officers of the University were engaged very directly and earnestly in the prosecution of special investigations. It was my purpose to show that a great share of the strength of the University was given to research and in-

* From the last quarterly statement of President Harper.

vestigation, as distinguished from administration and teaching. I desire at this time to indicate specifically, by way of illustration, the thought which at that time I endeavored to express. My illustrations are taken altogether from the Departments of Mathematics and the Natural Sciences. On a future occasion I shall use material which has been gathered from the departments ordinarily classed as the humanities.

The proposition which I wish to present is this: Nearly every member of every department in the university is to-day engaged in investigative work in which effort is being put forth to make new contributions toward the better understanding of the subject studied. I think it best under all the circumstances not to mention in this statement the specific names of persons thus engaged. In most cases, however, the mention of the subject itself will carry with it a knowledge of the person engaged in the work.

THE DEPARTMENT OF ASTRONOMY AND ASTROPHYSICS.

Mr. A is engaged in a systematic study of double stars with the forty-inch telescope. His great general catalogue of all known double stars in the northern heavens, which he has been preparing during the past twenty-five years, is about to be published by the Carnegie Institution.

Mr. B is engaged in a spectroscopic study of stellar motions with the forty-inch telescope. The results he has already published represent the highest degree of precision hitherto attained in this field. Through his initiative several observatories in Europe, Africa and the United States are cooperating in the observation of certain standard stars. The results of his investigations will serve as a basis for general studies of stellar relationships and motions, and also of the motion of the solar system with respect to the stars.

Mr. C is at work upon a triangulation of nearly 700 stars in various star clusters. These observations will serve as a basis for future investigations of the internal motions of these clusters. His observations of the Fifth Satellite of Jupiter are the only ones that have been obtained during the last five years, on account of the difficulty of observing this exceedingly faint object. In the cooperative plan of observing the minor planet Eros, participated in by many observatories in all parts of the world, he has obtained the most extensive series of observations, comprising over 1,500 measures on 73 nights. In addition to many other micrometrical observations with the large telescope, he has undertaken an extensive photographic survey of the Milky Way and other objects with the Bruce photographic telescope.

Mr. D is engaged in investigations on the motions of the minor planets, with particular reference to the characteristic planets of the Hilda type. He is also continuing his researches on effective potential forces.

Mr. E is engaged in a variety of theoretical investigations, most of which involve the application of the methods of modern mathematics to problems of celestial mechanics. He is giving special attention to a critical study of the nebular hypothesis on dynamical grounds, and is also at work on the theory of telescope objectives, with special reference to the use of non-spherical surfaces.

Mr. F's work on the design and construction of reflecting telescopes, and his photographs obtained with the two-foot reflector of the Yerkes Observatory have exercised a wide influence among astronomers. His color-screen method of converting a visual telescope into a photographic one has yielded excellent results with the forty-inch telescope and is being adopted in other observatories.

Mr. G is engaged in spectroscopic studies of various stars with the large telescope. This work relates particularly to certain very close double stars discovered by Mr. B and Mr. G with the Bruce spectrograph.

Mr. H is engaged in determining the brightness of a large number of stars, particularly those which vary in their brightness and which at minimum are beyond the reach of ordinary telescopes. Part of this work on very faint stars has been done in cooperation with two or three of the largest observatories in this country.

Mr. J's investigations relate to the general subject of stellar evolution, and are threefold in character:

1. Photographic studies of stellar spectra for the purpose of determining the physical and chemical condition and the order of development of certain great classes of stars. With the collaboration of two other members of the department, he has just completed an investigation of one of the two classes of red stars, including their chemical composition, physical condition, motion in the direction of the earth, order of evolution and relationship to the sun and other classes of stars.

2. Studies of the sun made for the purpose of elucidating both solar and stellar phenomena.

3. Laboratory investigations bearing on problems of solar and stellar chemistry and physics. With the collaboration of another member of the department, an investigation of spark spectra in liquids and compressed gases, and their bearing on the theory of temporary stars, has just been completed.

THE DEPARTMENT OF PHYSICS.

Mr. A is engaged in work upon a ruling engine for the production of diffraction gratings of a high order of perfection. Serious difficulties have been encountered, but considerable progress has been made upon this most important piece of work, and at present the prospect of attaining the end sought is highly encouraging. The efficiency of the gratings which it is hoped this machine will make will be at least twice that of the best gratings which have yet been produced. The difficulty of making a grating with twice the efficiency is as much greater than that of making the gratings which have been produced as the difficulty of making a telescope objective of eighty inches diameter is greater than that of making one of forty inches diameter.

Mr. A has also just begun an investigation of the effect of various agencies upon the position, breadth, distribution of light and intensity of spectral lines. He further expects to take up soon the problem of the velocity of light.

Messrs. B and C are engaged in the publication of a series of text-books which contain the most important of the undergraduate courses in physics which have been developed here. This work is considered necessary in order that the university may exert an adequate influence upon physics-teaching throughout the country. Two of these texts have already appeared and two more are nearing completion.

Mr. B is also cooperating with the Departments of Mathematics and Pedagogy in an endeavor to improve the teaching of mathematics and physics in the secondary schools, and is about to begin the collection of Mr. A's scattered works for publication in a single volume.

Mr. C is, in addition, engaged in an investigation of the nature of electric discharge in high vacua. This investigation is designed to test an important point in the modern electron theory of matter.

Mr. D is in the midst of a research upon the relation of the sparking potential and the spark distance for distances of the order of the mean free path of the molecule.

Mr. E is assisting Mr. A in the perfection of the ruling engine, and is also cooperating with Mr. C in the production of a physics text-book for elementary schools.

Mr. F is engaged upon two pieces of research: (1) an examination of the conditions which govern the coherence between metals; and (2) the influence of hysteresis upon electric resonance. Preliminary results of these investigations were presented by Mr. F to the American Association for the Advancement of Science at its recent meeting in Washington.

Mr. G is determining the index of refraction of sodium vapor for that portion of the spectrum which contains the sodium lines.

THE DEPARTMENT OF CHEMISTRY.

Mr. A is at present engaged upon a study of dissociation phenomena in the glycerine-glycol series, as well as in the sugar group.

Mr. B is making a study of equilibrium conditions in calomel vapor, and also between amorphous and soluble sulphur.

Mr. C is conducting two lines of work: (1) studies on molecular rearrangement, and of saponification and hydrolysis of organic compounds by physico-chemical and synthetic-organic methods; and (2) studies on the existence of positive halogen ions.

Mr. D is conducting work upon the dissociation constants of dibasic acids.

Mr. E upon the constitution of salts of organic cyanogen compounds.

Mr. F upon dialkyl derivatives of hydroxylamine.

THE DEPARTMENT OF GEOLOGY.

Mr. A is engaged in the investigation of the Kinderhook faunas of the Mississippi valley.

Mr. B is engaged upon the graphical expression of the chemical composition of igneous rocks, with reference to their mineral constitution and their classification.

Mr. C has under investigation the glaciation of the western mountains and the geology of the coastal plain.

Mr. D is working upon a group of problems relating to the origin and early stages of the earth and upon the system of dynamics connected therewith.

THE DEPARTMENT OF ZOOLOGY.

Mr. A is studying (1) the evolution of species as indicated in the genetic relations of color-patterns, voices, instincts, and general life-histories; (2) experiments in hybridizing species, to ascertain, if possible, general laws governing the transmission of hereditary characters, and the conditions necessary to creation of new species.

Mr. B (1) the method of evolution. The quantitative study of the changes that a species undergoes in different localities and in different geological periods at one locality. Illustrated by studies on the shells of the mollusk known as the 'scallop' (*Pecten*) from different points on the coast of North America and Europe and from fossil beds in Virginia.

Mr. C is working on problems in embryology: (1) the rôle of cell-division in development; the relation of the process of cleavage of the ovum to the formation of an embryo; (2) the investigation of the problem of correlative differentiation, *i. e.*, the influences exerted by parts of an embryo upon the development of other organs; more particularly, at present, the mechanics of development of the amnion in the chick; and allantois; and the influence of the nervous system in the formation of organs.

Mr. D is engaged in experimental study of problems connected with regeneration: (1) the factors influencing regeneration and the effect of altered conditions; (2) the differentiation of the regenerating structures and the differences between regenerated and original structures; (3) the physiology of form and form-regulation, *i. e.*, the return to normal or typical form, after experimental alteration of form and especially the effects of physical factors, *e. g.*, pressure, tension, etc., upon form in the lower invertebrates.

Mr. E is making experiments and statistical investigations of the relations existing between some of the factors of the environment, *i. e.*, temperature, humidity, food, topography, etc., and the production of variations in insects, especially in the color-patterns of coleoptera; (2) investigating the evolution of large genera and of groups of small genera, to determine if possible what causes are the dominant ones in the production of new races and species, and the conditions necessary for their preservation; based upon the experiments and statistics (1) and the ontogeny and phylogeny of color-patterns, color variations, and geographical distribution.

THE DEPARTMENT OF ANATOMY.

Mr. A is conducting research in problems of anatomy and pathology of the nervous system and in infectious diseases.

Mr. B has completed, since coming to the university, two papers: one on the structure of the cardiac glands of mammals; the other, the structure of Brunner's glands in mammals. He has under way three other researches: (1) on the structure of Paneth cells; (2) on the histology of the gastric glands of vertebrates; (3) on the structures of the human stomach. It is to be

noted that these researches deal with the finest structures of the digestive tract.

Mr. C has made extensive researches in general anatomy, especially in vertebrate embryology. His experiments on the formation of the embryo in fish and amphibia are well known. More recently he has taken up the study of histogenesis, especially of fibrillated muscle cells and their nuclei. At present he is engaged upon a study of spermolysins and ovolysins.

Mr. D has been making contributions to our knowledge of the anatomy of the spleen, especially its framework, but is better known through the work of the last year and a half, conducted chiefly with Professor Ehrlich in Frankfurt, upon the nature of poisons which act upon the blood, especially snake poison. His studies have attracted international attention and have a wide bearing upon blood poisons in general.

Mr. E has made a special study of the anatomy of the ducts and blood-vessels of the pancreas of the hog and their origin in the embryo and has published part of the results. He is now engaged upon the study of the framework and wandering cells of the mucous membrane of the human stomach.

Mr. F is engaged upon the study of the arrangement of the connective tissues in the mammalian larynx and the study of the histogenesis of the laryngeal glands in the pig.

Mr. G is engaged upon the study of the morphology of the head in vertebrates, and on the study of the changes in the structure of the mucous membrane of the stomach following the operation of gastroenterostomy.

Mr. H is making important observations in methods of staining nerves with methylene blue and with Bethe's neuro-fibril method. These studies have been concerned chiefly with the degeneration of axones and nerve endings after nerve section or local pressure; and further with the effect of electrical stimulation on the structure and vital staining properties of nerve endings.

Mr. J has worked out the distribution of the blood-vessels in the labyrinth of the ear of *Sus scrofa domesticus*, the results appearing in the Decennial Publications of the University. He is now engaged upon the study of the structure and function of the *stria vascularis*. He spent a great deal of time and care in the preparation of casts and injections to form material for his special course.

THE DEPARTMENT OF NEUROLOGY.

Mr. A is at work on the change in the percentage of water in the nervous system of the white rat during the period between birth and full maturity.

Mr. B is making a study of the relative activity of the white rat at different ages and at different hours of the day.

Mr. C is working on the effects of lecithin on the growth of the central nervous system.

Mr. D: on the law for the distribution of the nerve fibers which innervate the leg of the frog.

Mr. E: on an enumeration of the medullated nerve fibers in the dorsal and ventral roots of the spinal nerves of man.

Mr. F: on the psychical development of the young white rat correlated with the growth of its nervous system.

Miss G: on the mode in which the white substance of the spinal cord of the rat increases in area.

Mr. H: on the healing of wounds of the brain at different ages between birth and maturity.

Mr. J: on the axone reaction as observed in the nucleus of the third cranial nerve of the white rat.

THE DEPARTMENT OF BOTANY.

Mr. A is engaged in studying problems connected with the origin and evolution of seed plants. A book, just going through the press, for the first time organizes the subject for the benefit of advanced and research students.

Mr. B is at present investigating the problems of fertilization among the lower plants. The results are distinctly pushing out the boundaries of our knowledge of one of the most fundamental life-processes.

Mr. C is investigating cytological problems among plants, and is completing an important contribution to our knowledge of the methods of nuclear division.

Mr. D is a large contributor to plant ecology, and is now engaged in organizing the

subject for its first publication as a university text.

Mr. F has been investigating certain important problems presented by the club-mosses, among which the origin of the seed-habit is prominent.

Mr. G is engaged in investigating the causes of the forms assumed by plant bodies, as shown chiefly by lower plants. He has shown experimentally that form is in the main a phenomenon of chemistry and physics, and not to be explained by any mystical vitalistic theory.

Mr. H is investigating the ecological problems that underlie scientific forestry, his field of operations having been chiefly in the Rocky Mountains of Montana. He has just made an important report to the government on that region.

Mr. J has in preparation a book for students of plant physiology in which for the first time the subject will be considered from the standpoint of modern chemistry and physics.

THE DEPARTMENT OF BACTERIOLOGY.

Mr. A is engaged upon a study of some of the poisonous substances produced by bacteria, especially those that affect the red blood-corpuscles. He is also preparing evidence to be used in the suit between the states of Missouri and Illinois concerning the Chicago Drainage Canal.

Mr. B. has nearly completed a piece of work upon some disease-producing organisms found in human blood and closely related to the typhoid bacillus.

THE DEPARTMENT OF PALEONTOLOGY.

The work upon which Mr. A is at present engaged, and which will occupy the large part of the next two years, is a monographic study of the extinct orders of Mesozoic reptiles known as the Pterodactyls and Plesiosaurs. This investigation is aided by a grant from the Carnegie Museum.

Under the combined direction of Mr. A and Mr. B, and with Mr. C's cooperation, Mr. D, a fellow, is engaged upon a study of the fossil diptera of America, based chiefly upon a collection loaned to the Department by the U. S. National Museum.

THE SCHOOL OF GEOGRAPHY IN THE SUMMER SESSION OF CORNELL UNIVERSITY.

Interest in geography as a school subject has grown rapidly within the past ten years. Courses have multiplied in the summer sessions of the universities, and an increasing number of teachers in secondary and grade schools have awakened to their need of better training both in subject matter and in methods of treatment. More than a dozen of the larger universities now accept the subject for admission, and examinations are regularly offered by the College Entrance Examination Board.

These facts give special meaning to the organization of the Cornell School of Geography under the direction of Professor R. S. Tarr. Although following upon the discouraging typhoid epidemic of last winter, the health of the school was excellent, and the attendance much larger than was expected, including grade, normal and high school teachers and superintendents from seventeen states.

The courses and instructors were as follows: Physiography and geography of Europe, Professor R. S. Tarr; dynamic geology and geography of the United States, Professor Albert P. Brigham, of Colgate University; home geography and type studies in geography for grammar grades, Dr. Chas. A. McMurry, of Northern Illinois Normal School; commercial geography, Principal Philip Emerson, of Lynn; class-room problems and laboratory methods for the grades, Supervisor R. H. Whitebeck, of Trenton State Normal and Model Schools; laboratory in geography, Assistant Principal Frank Carney, of Ithaca; laboratory in geology, Mr. Geo. C. Matson, of Cornell University.

A large number of field excursions were made, in the vicinity of Ithaca, and to more remote points such as Watkins Glen, Lake Ontario and the coal region about Wilkesbarre. On one evening of each week a round table conference gave opportunity for informal dis-

cussion of school problems in geography and comparison from a wide range of experience.

It is expected that the school will be continued in 1904 with the same faculty. All the courses given this year, and some additional work, will be offered. A. P. B.

THE MALARIA EXPEDITION TO THE GAMBIA.

AN abstract in *Nature* states that the Liverpool School of Tropical Medicine has issued a report on the prevention of malaria in the tropics with reference to the Gambia. Dr. Dutton, who conducted the expedition shows how a great deal of disease is due to the want of knowledge of the nature of malaria, and that during the dry season the residents are largely to blame for the appearance of the disease. The object of the expedition was to investigate the conditions under which mosquitoes were propagated in the town of Bathurst and at the principal stations of the colony, and to suggest methods of destroying these insects. Malaria was found to be prevalent in the colony; 80 per cent. of the native children examined harbored malaria parasites in their blood. The liability to infection of the Europeans commences soon after the rains are established, lasting up to the end of November. The various breeding places of mosquitoes are described in detail in chapter IV. of the report, particular mention being made of the wells, canoes, boats, lighters, cutters on the foreshore, and of the grass-clogged trenches in many of the streets, which together supply Bathurst with the majority of its mosquitoes during the wet season and for part of the dry season. The number of mosquito breeding places present in compounds was found to vary with the social position of the occupier. They increased in extent and number in proportion to the wealth and position of the occupier.

In one factory yard were found six barrels, and in the garden there were seventeen tubs and eight small wells, all breeding quantities of *Culex, Stegomyia,* and *Anopheles* mosquitoes. Besides these dry season breeding places, discarded domestic utensils were scattered about the yard and garden which, in the wet season, would have acted as breeding places. It is pointed out that during the dry season, from November to May, natural breeding places for mosquitoes in Bathurst cease to exist, and from this period the people breed mosquitoes solely in their own compounds.

In chapter V., which deals with the prevention of malaria in Bathurst, a campaign against the mosquito is advocated; the town is judged especially suitable for its success. Thus Bathurst is situated on a practically isolated piece of land surrounded on nearly all sides by a broad expanse of sea water. The amount of land to be dealt with is comparatively small, viz., about a square mile. The surface is fairly level, sandy, absorbing water readily. In this area the breeding places of mosquitoes are a known quantity, the artificial, or those made by man, being in excess of the natural. The rainfall is very small, and rain occurs only during four out of the twelve months of the year.

The probability of the introduction into Bathurst of yellow fever from Senegal is pointed out as another reason for attacking the mosquito. The expedition was informed by His Excellency, the acting Governor, H. M. Brandford Griffith, of the intention on the part of the Colonial Government to enter upon a crusade against the mosquito, and on November 18 the preliminary removal of rubbish from houses and compounds began; a sanitary inspector was appointed, and received special instruction in the work. Under him worked a gang of laborers, and at the time of the departure of the expedition (January 10) 363 houses and compounds had been inspected. From these 131 cartloads of old tin pots and other rubbish were removed. On the return of His Excellency the Governor, Sir George C. Denton, the inspector and a sufficient staff of laborers were appointed permanently, and a grant of £200 per annum was given for the special anti-mosquito work. Anti-mosquito regulations have been drawn up by the Colonial Government.

An appendix, by Mr. F. V. Theobald, is attached to the report; in it are described the various species of mosquitoes collected by the expedition, many of which were new to science.

SCIENTIFIC NOTES AND NEWS.

Dr. E. B. Copeland, instructor in bionomics, at Stanford University, has been appointed chief botanist of the United States Philippine Commission. A. D. E. Elmer, assistant in systematic botany, has been appointed assistant field collector on the same commission.

The British Rainfall Organization founded in 1860 by the late G. J. Symons, will henceforth be carried on under the sole charge of Dr. H. R. Mill, as Mr. Sowerby Wallis has been compelled by ill health to retire after more than thirty years connection with the association.

Jamaica has abandoned its weather service and Mr. Maxwell Hall, government meteorologist, has resigned the position which he has held since 1880. The compilation of the weather reports will hereafter be undertaken by the Chemists' Department.

The Hanbury Gold Medal of the Pharmaceutical Society of London has this year been awarded to M. Eugène Collin.

George Benjamin White (Ph.D. Yale) has been appointed assistant in the Department of Bacteriology, of the Hoagland Laboratory in Brooklyn.

Dr. Frank Russell has resigned the instructorship of anthropology at Harvard University, which he has held since 1897. Owing to his health, he will live on a ranch in Arizona.

Professor S. J. Barnett, of the Department of Physics of Stanford University, has returned from Alaska, where he had charge of a party, sent out by the U. S. Coast and Geodetic Survey.

Governor La Follette, of Wisconsin, has appointed a commission, consisting of Dr. Gustav Schmitt, Milwaukee, Professor H. L. Russell, bacteriologist at the State University, Madison, and Dr. M. R. Merrill, whose duty it is to determine the advisability of the establishment of a state hospital for the treatment of tuberculosis.

Secretary Wilson, of the Department of Agriculture, gave this week an address before the Irrigation Congress, meeting at Ogden, Utah.

President A. T. Hadley, of Yale University, was a passenger on the steamer *Prinzess Irene* which arrived at New York last week from Mediterranean ports.

Anton J. Carlson, Ph.D., of Stanford University, who was appointed research assistant by the Carnegie Institution last year, is now at San Diego doing research work in the temporary laboratory of the University of California. The subject of his investigations is 'the mechanism of the inhibition of the heart in invertebrates.'

During the past year Mr. T. W. Vaughan, of the United States Geological Survey, has devoted most of his time to a study of the later Tertiary corals of the United States and the West Indies. The manuscript of his monograph is far advanced and illustrations for sixty or seventy plates have been prepared.

Captain Lefant, of the French army, is about to explore the Niger Basin, under the auspices of the Paris Geographical Society and the French Colonial Office.

A bust in honor of the late Mr. W. Martindale will be unveiled at the London School of Pharmacy on October 1, when Dr. J. W. Swan, F.R.S., will make an address in connection with the opening of a new section of the school.

There has been unveiled at Langres, France, a monument in honor of the chemist, Laurent.

The deaths are announced of Dr. Eugen Askenasy, honorary professor of botany in the University of Heidelberg, at the age of fifty-eight years, of Dr. J. Lange, the mathematician, director of a Berlin Realgymnasium, at the age of fifty-seven years, and of Ernst Krause, who wrote on popular natural history under the name Carus Sterne, at the age of sixty-four years.

Mr. W. W. Astor has contributed $100,000 to the British Cancer Research Fund.

At the instance of Dr. N. L. Britton, director of the New York Botanical Garden,

the buildings at Cinchona relinquished by the government of Jamaica have been rented for a tropical botanical laboratory.

THE daily papers state that large crowds are visiting the American Museum of Natural History, New York, to see the specimen of radium there on exhibition, which was presented by Mr. Edward D. Adams.

THE Chemical Laboratory of the University Modena, including a scientific library containing 15,000 works, has been destroyed by fire.

THE Farmers' National Congress will hold its twenty-third annual session at Niagara Falls, beginning on September 22. Among the general addresses of scientific interest on the program are: 'Infectious and Contagious Diseases of Farm Animals and their effect on American Agriculture,' Dr. D. E. Salmon, Washington, D. C.; 'Insect Pests of Plants and their effect on American Agriculture,' Professor F. M. Webster, Urbana, Ill.

THE British *Journal of Education* states that the council of the Royal Geographical Society has at the request of the London School Board and the Oxford and Cambridge School Examinations Board drawn up syllabuses as guides to instruction in geography in elementary and in secondary schools. The elementary suggestions were drafted by the late Mr. T. G. Rooper, H.M.I.S., and, after his death, they were revised by Mr. G. G. Chisholm, M.A., B.Sc. The secondary were drafted by Mr. H. J. Mackinder.

THE British Government has appointed a commission to inquire into the alleged physical deterioration of the lower classes, with Mr. Almeric W. Fitzroy, clerk of the privy council, as chairman.

THE daily papers state that the legacy of M. de Pierrecourt, who left his money to the city of Rouen for the purpose of founding a family of giants, with a view to the physical regeneration of the human race, has been before the Council of State in Paris. An arrangement has been arrived at by which the city of Rouen undertakes to apply a sum of 800,000f. out of the testator's estate to the foundation of a useful institution, and to pay over the rest of the estate to M. de Pierrecourt's heirs.

CASES of illness including four deaths have occurred at Marseilles which are attributed to the plague, while in northern Mexico there is an outbreak of yellow fever, which is now being investigated by the Health Department of Texas.

THE U. S. Geological Survey has established seven new river stations and renewed four of the five old stations in North Dakota, so that eleven stations are now in operation in this state. The stations in the eastern part of the state have been established to determine the amount of water power available and for other general purposes. In the western part of the state, which is semi-arid, the stations have been established to determine the amount of water available for irrigation. This region has no large rivers except the Missouri, which has only a small fall, not so great as most irrigation canals. It is not probable, therefore, that this stream can be used for irrigation purposes until a later time, when the land shall have become more valuable. A thorough examination is being made of all the streams and the lands in North Dakota west of the Missouri River with a view to irrigation projects. If any project appears to be favorable, detailed surveys and estimates may be made, and, if the project is then found feasible, it will be recommended for construction. An examination is also being made of the cheap and abundant lignite resources of the state in the hope that lignite can be utilized for fuel in pumping water for irrigation in certain localities, where long canals would be impracticable.

THE London correspondent of the *Journal of the American Medical Association* calls attention to the statistics of the birth rate in Australia, recently collected by Mr. Coglan. The fall in the birth rate in Australia and New Zealand taken together is such that there are annually fewer births by nearly 20,000 than would have occurred if the rates prevailing as late as ten years ago had been maintained. New South Wales furnishes a stri-

king example. In 1887 there were in this state 112,247 married women under the age of 45; in 1901 there were 149,247, yet the number of children born was about the same in each year. The legitimate birth rate per 10,000 married women under the age of 45 is 239; in 1891 it was 276. A curious fact is that the decline occurs in every class, among people of every shade of opinion, except among women of Irish birth, who exhibit no decline. But as the proportion of women of Irish birth is fast decreasing that element in maintenance of the birth rate will soon disappear. Large as is the area of the Australian continent Mr. Coghlan thinks it is impossible that its people will become truly great under the conditions affecting the increase of population which now exist. Immigration has practically ceased to be an important factor, the maintenance and increase of the population depending on the birth rate alone—a rate seriously diminished and still diminishing.

UNIVERSITY AND EDUCATIONAL NEWS.

Professor F. D. Tucker, principal of the school of agriculture of the University of Minnesota, has been elected and has entered upon his duties as president of Memorial University, Mason City, Ia. This institution was founded about two years ago as a memorial to the Grand Army of the Republic. One building, the College of Arts, costing $100,000, has already been erected and will be occupied during the coming year.

University College, Reading, has received towards the cost of the new buildings £10,000 from Lady Wantage, widow of Lord Wantage, who was president of the college from 1896 to 1901; £10,000 from Mr. W. G. Palmer, M.P.; and a third £10,000 from three other contributors.

The Leeds Corporation technical instruction sub-committee, with the approval of the finance committee, has decided in the event of a charter being granted to the Yorkshire College, to give £4,000 a year towards the University funds, in addition to the £1,550 granted from the residue of the local taxation.

Dr. Burton D. Myers, assistant in anatomy at the Johns Hopkins University, has an appointment as instructor in anatomy in the Indiana State University.

Dr. C. H. Gordon, until recently superintendent of schools at Lincoln, Nebr., and instructor in geology and geography in the University of Nebraska, has been appointed acting-professor of geology in the University of Washington to take charge of the work of Professor Henry Landes, who has been granted a year's leave of absence for study in the University of Chicago.

The following is a list of appointments in the scientific departments of the University of Maine for the coming year: H. S. Boardman, B.C.E. and C.E., University of Maine, professor of civil engineering; W. N. Spring, B.A. and M.F., Yale, professor of forestry; W. D. Hurd, B.S., Michigan Agricultural College, professor of agriculture; A. W. Cole, B.S., Worcester Polytechnic Institute, instructor in shop-work; H. P. Hamlin, B.C.E., University of Maine, instructor in civil engineering; G. T. Davis, B.A., and J. B. Reed, B.A., of the University of Michigan, instructors in chemistry; E. H. Bowen, A.B., Colgate, tutor in physics; P. D. Simpson, B.S., University of Maine, tutor in civil engineering; R. M. Connor, B.S., University of Maine, tutor in mathematics; Edith M. Patch, A.B., University of Minnesota, entomologist in the experiment station; S. C. Dinsmore, B.S., University of Maine, assistant chemist in the experiment station.

Professor Authenrieth, of Freiburg, has been called to a professorship of chemistry in the University of Greifswald; Dr. Krigar-Menzel, docent in physics in the University of Berlin, has been appointed acting professor in the Technical Institute at Charlottenberg; Dr. Armin Tschermak, docent in physiology and assistant in the Physiological Institute of the University of Halle, has been promoted to a professorship, and Dr. Wilhelm Küster has been appointed professor of chemistry in the Veterinary School at Stuttgart.